

NASA NDE WORKING GROUP NEWSLETTER

April 1995

Quarterly Newsletter

VOL. 3, NO. 2

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NASA HQ CODE Q W MESSAGE (J. Siedlecki, 202-358-0205)

The final results of the recent Pre-POP call for RTOP funding are not available at this time. The process has been delayed from the originally scheduled end of April to the end of May. This will allow extensive re-work of several program areas, e.g., software and IEEE parts. I want to thank all of you for your timely inputs to Dr. Chern, GSFC, and would like to take this opportunity to express my appreciation for his efforts to integrate/coordinate the NDE Working Group RTOP priority rankings into their final form. This effort will be of great value to me as a means to advocate NDE projects during the 1'01' process.

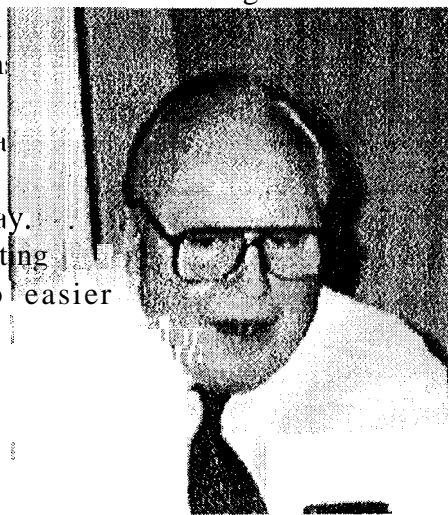
On a sadder note, the scaling back of the Vitro support contract has led to the re-assignment of Dr. Ted Lynch. During my limited tenure, he has proven to be a valuable resource in my efforts to "come up to speed" in the NDE world. His expertise has provided me with NDE background, advise and facilitated my efforts as the NASA Program Manager for NDE. I will miss his council and the NDE program will miss his advocacy. We wish him well in his new endeavor.

The letter announcing the NDE working group workshop at MSFC during the 8th thru 11th has been signed and I'm looking forward to seeing all of you at Huntsville, Alabama. Dr. Greenfield, Deputy

Associate Administrator for OSMA, will join us for the first full day and looks forward to the status briefings on the on-going RTOP projects.

NASA HQ(VITRO)FAREWELL MESSAGE (Dr. C. Ted Lynch, 202-646-6372)

It has been a great pleasure for me to work with many of you for more than five years, and with all of you since the Working Group formation meeting at JSC in April 1993. Since that time you have made a great deal of progress in achieving the goals that you envisioned for yourselves, to the advantage of NASA and the NDE community. All of us feel the pressure of the changes that are occurring within the Agency at this time, and I feel that it is even more important now that you represent the needs and concerns for a strong NDE program for the Agency. I have been encouraged by your dedication and willingness as individuals and as a Working Group to participate and contribute to the welfare of all of you and your programs in a substantive way. Your willingness to serve and assist me in the work of supporting Headquarters and your Program Manager made my job easier and a great deal of fun. You all have been a joy to work with, and I will miss the personal aspects of getting to know so many of you. I am being reassigned to other duties here and Yoseph has kindly provided me an opportunity to say thanks to you and to my Headquarters counterpart here, Joe Siedlecki. I have enjoyed supporting him and encourage you to continue your excellent support of him and the NDE program area.



Dr. Ted Lynch, Vitro

FORMER CHAIRPERSON MESSAGE (M. Havican, 713-483-7134)

The second year of the NN WG has ended. In accordance with the NN WG charter, Dr. Y. Bar-Cohen has become our Chair, and Dr. George Baaklini has been elected Vice-Chair. Congratulations, Yosi! and George !

In the past year, we have had a good amount of activity. Our first Directory was sent out by John Larson. The Code Q Standing Committee, under the leadership of Dr. Jim Chern, refined the RTOP Review Process. I A-. Bar-Cohen continued to publish the Newsletter on a quarterly basis and increased its circulation. Marie Havican, Dr. Bar-Cohen and Bob Neuschaefer presented an overview of NN WG activity to Dr. Michael Greenfield, Deputy Associate Administrator for OSMA, and Guy Gardner, Code QW I Director. Our Strategic Plan is approaching completion with the final review to be held with the entire Working Group next month.

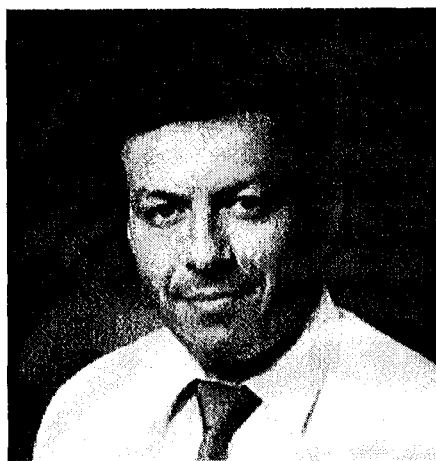


Marie Havican, JSC

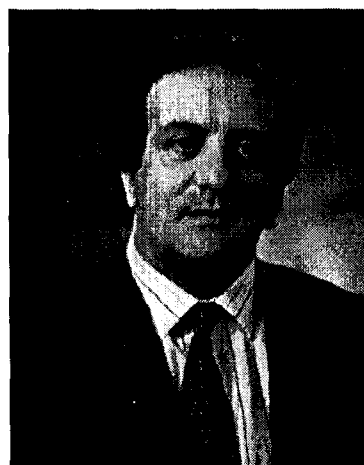
As a final note, we had support all year from Joe Siedlecki and Dr. Ted Lynch. Dr. Lynch has moved on, but his energy and positive attitude helped get our group off the ground, and he will be missed.

NNWG HIGHLIGHTS (Dr. Y. Ilar-Cohen, 818-354-2610 & Dr. George Baaklini 216-433-6016)

As most of you know by now, and Dr. George Baaklini was elected as the new NNWG ViceChair and I became the new Chairperson. I would like to congratulate George and we are looking forward to another effective and successful year for the Working Group. We would like to thank Marie Havican for her being last year NNWG'S Chairperson and for her continued assistance in editing our NNWG Newsletter. As the demands for cheap, faster better are increasing, there are growing technical and fiscal challenges to NNWG, where the assurance of the quality of NASA flight hardware is continuing our prime concern. Increasingly, we are relying on the information superhighway which rapidly is networking our community and I am pleased to mention that most of our members have now an E-mail address. The ability to simultaneously communicate messages at the speed of a keyboard stroke make it a very powerful tool. To review where we are and where we are going to hold the 2nd NASA NDE Workshop at MSFC, Huntsville, AL from May 8 to 10, 1995. We will be honored with the participation of Dr. Michael Greenfield, Deputy Associate Administrator for OSMA, in the first day of the Workshop.



Dr. Yoseph Ilar-Cohen, PI.,
NNWG Chairperson



Dr. George Baaklini LeRC,
NNWG Vice-Chairperson

Our NNWG Newsletter is getting a growing interest nationally and its distribution is covering individuals throughout NASA, DoD, FAA, technical societies, industry, and academia. To disseminate the information about our Working Group, its goals and accomplishment, I am attaching to this Newsletter a reprint of the article that was published in the August 1994 issue of Materials Evaluation.

CODE Q STANDING COMMITTEE HIGHLIGHTS (Dr. E. J. Chern, 201-286-5836 and R Neuschaefer 205-544-7382)

RECOMMENDATION FOR CODE Q FY'96 NDE RTOP FUNDING - Pertaining to the Telecon on February 16, 1995, Code Q committee has completed the evaluation of NDE RTOP proposals. There was a total of 14 submittals with \$2.27M funding request. The submittals were limited to 4 proposals and up to \$500k per Center including multi-center programs. Each proposal was evaluated against criteria similar to those of last year's: Benefit to NASA/OSMA, Program Needs, Cost/Risk

Assessment and Technology Transfer. There were no Center's self-evaluations. In late February, the Code Q Committee submitted the result to Mr. Siedlecki for consideration. The ranking of the top ten programs is as follows

- #1 - UT NDE of Composites Integrity - Dr. Y. Bar-Cohen, JPL, and Dr. E. Madaras, LaRC
- #2 - Reflectometer Development - H. Dooley and J. Gilis, KSC
- #3 - Valve Health Monitoring and Control - R. Johnson and J. D. Collins, KSC
- #4 - integrated Eddy Current imaging Workstation - Dr. J. Chern, GSFC
- #5 - Engineering Tomography of Engine Components - Dr. G. Baaklini, LaRC
- #6 - Laser Induced Multiple NDE - Dr. Y. Bar-Cohen, JPL, Dr. E. Madaras, LaRC, and Dr. S. Russell, MSFC
- #7 - NDE Documents, STD and Guidelines - Dr. Y. Bar-Cohen, JPL
- #8 - NDE for Fracture Control and Life Assessment - C. Salkowski, JSC
- #9 - Bolted Joint NDE - Barden and J. D. Collins, KSC
- #10 - Development and Technology Transfer of Spectral Ultrasonic Homogeneity Characterize - Dr. G. Baaklini, and Dr. G. Roth, LaRC

NNWG PERSONNEL NEWS AND ACHIEVEMENTS

We would like to congratulate Dr. Ed Generazio for becoming the Head of the Nondestructive Evaluation Sciences Branch NASA at LaRC. Dr. Generazio officially replaced Dr. Joseph Heyman.

In April, Charles Salkowski was promoted to Branch Chief of the new Branch Chief, Manufacturing and Process Development, JSC. Congratulations and Good Luck, Charles!

As reported in the previous issue of the Newsletter, Joe Halupnik of JSC, our NDE Program Administrator and Engineer, has earned his seventh ASNT Level III certification. To add to the significance of this accomplishment, Joe was listed in the February 1995 issue of Materials Evaluation as one of only eight people in the United States with seven Level III Certifications. Further, no one in the U.S. is listed as being level III in more than seven methods. A second round of congratulations to Mr. Halupnik is in order for this outstanding achievement in the field of NDE.

We would like to welcome Dr. Mike Lih from JPL. Dr. Lih joined the NDE team at JPL in February.

Dr. Ted Lynch have been reassigned and is not going to continue his involvement with our Working Group. Ted has been a great help to our activity and we sure going to miss him. We would like to wish him good luck in his new assignment, where he is going to continue being a great asset.

Alex Vary has retired. Alex has been one of NASA NDE celebrities and we are going to miss his contribution to NASA in NDE. We would like to wish him enjoyable retirement.

PRÉCIS FOR ALEX VARY (Dr. George Baaklini, 216-433-601 6)

Alex Vary has retired from NASA's Lewis Research Center where he worked for over 36 years. He began his career during the era when NASA earnestly planned "manned" missions to Mars. The idea was to use nuclear energy to power space ships and planetary outposts. Vary's first assignment was to conduct research in thermoionics, a method for converting nuclear thermal energy directly into

electricity for auxiliary power. He then conducted research in liquid metal heat transfer for nuclear power conversion. The latter work also involved a study of deleterious effects of liquid metal corrosion and mass transfer. Vary was engaged in this work from 1958 to 1969 when all nuclear work was halted.

The experience he gained made it natural for Vary to become an advocate of nondestructive evaluation methods which he had been applying during the construction and study of nuclear power systems. Because of his keen interest in NDE he was asked to establish an NDE laboratory for the Lewis Research Center. The laboratory was Inaugurated in 1970 and Vary guided its progress to his retirement in 1995. As the Lewis Research Center's mission changed from nuclear Power systems to aircraft propulsion, Vary's NDE facility continued to write the Center's and NASA's Interests. Concurrently, the material systems addressed by NDE changed from refractory metal containment for nuclear power to high temperature composites and ceramics for advance aircraft engines.

Vary has been granted seven US patents and has authored and co-authored over 100 technical reports and papers. He has edited three books on NUB and authored the Materials Characterization section of the ASNT Ultrasonics Handbook. He is editorial board member of the Journal of Acoustic Emission and the international Advances in Nondestructive Testing series of Gordon and Breach, Science Publishers. He is also a member of ASNT's Research Council and Sonics Committee and chairs ASTM committees on NDE for Advance Ceramics (C-28) and on Acousto-Ultrasonics (E-07). Vary plans to continue his work with ASNT and ASTM while serving in an advisory capacity to his colleagues at Lewis Research Center.

Vary has received awards from a number of organizations including several NASA technical achievement awards, and the Northeastern University IBM Lecture and University of Illinois Engineering Achievement awards. He also received the ASNT Outstanding Achievement Award in 1980 and the NASA Exceptional Engineering Achievement Medal in 1991. He gave the 1989 ASNT Fall Conference Keynote Address and the 1992 ASNT Lester Honor Lecture. In 1994, Vary was elected Fellow of the American Society for Nondestructive Testing and also received the first Abc Silverstein Medal for outstanding research contributions at the Lewis Research Center.

NASA CENTERS NEWS AND ANNOUNCEMENTS

GSFC (Dr. E. J. Chern, 301-286-5836)

UPPER MANAGEMENT CHANGE IN GSFC AND OFFICE OF FLIGHT

ASSURANCE - Mr. Tom Huber retired March 31, 1995 as the Deputy Director of GSFC, a position he has held since June 1994. Prior to this position, Mr. Huber was the GSFC's Director of Engineering since March 1990. Dr. John Klineberg resigned as the Director of GSFC, effective April 30, 1995. Mr. Joseph Rothenberg was appointed the Deputy Director of GSFC by NASA Administrator Mr. Daniel Goldin. He started reporting to work on his new assignment from April 24, 1995. Prior to this appointment, Mr. Rothenberg was the Project Manager for the Hubble Space Telescope Project until he resigned from GSFC in February 1994. Mr. Wentworth Denoon was selected as the Deputy Director of Office of Flight Assurance effective April 10, 1995. Prior to this position, Mr. Denoon was the Chief of Assurance Management Office.

JPL (Dr. Y. Bar-Cohen, 818-354-2610)

NNWG NEWSLETTER AS A MOSAIC HOMEPAGE - As of the last issue of the NNWG Newsletter, all issues are now being loaded onto the NDE Homepage system that was dedicated on the JPL Engineering Design Management System (EDEMAS) server. This NDE Homepage system is available on Internet via the World Wide Web using the Mosaic public domain software. The URL address, which is accessible to Non-NASA users is:

<http://nasa-ndc.jpl.nasa.gov/jpl-nde/homepage.htm>

DR. MIKE LIB HAS JOINED THE NDE TEAM AS A MEMBER OF THE TECHNICAL STAFF -

He has been a Research Engineer at the Mechanical, Aerospace and Nuclear Engineering Department, UCLA from 1992-1994. His technical expertise are dynamic response of composite materials and structures, nondestructive evaluation of materials, adhesive joints and thin films, mechanics of advanced materials, finite element analysis, and modeling and analysis of aerospace structures and components. Dr. Lib has been a consultant at JPL since 1993 where he developed and performed a series of ultrasonic experiments to characterize the elastic properties of composite materials, adhesive joints, and damping of materials and demonstrated that the calculated wave forms based on the suggested models are in remarkable agreement with laboratory data.



Dr. Mike Lib, JPL

REMOTE SURFACE INSPECTION SYSTEM (Dr. Paul Backes, 818-354-3850) - During the planned thirty year lifetime of NASA's Space Station Freedom, significant surface damage is expected from micro-meteorite impacts, atomic oxygen degradation, and other effects. Since continual direct astronaut inspection of the station is not feasible, NASA has been investigating telerobotic methods with a prototype inspection system developed by the JPL's Remote Surface inspection research task. The inspection system is comprised of three subsystems: robot manipulation, graphical user interfacing, and multi-sensor inspection. The manipulator is a Robotics Research K 1207 arm mounted on a translating platform. The user interface resides on a graphics workstation and provides user-friendly interfaces to the manipulator control and the inspection data. The multi-sensor inspection subsystem gathers and analyzes data from a realistic Space Station mockup under simulated orbital conditions.

The system evolves around multi-sensors that is a compact (3.5 kg) Integrated Sensor End-effector (ISEE). The ISEE has two cameras and illuminators needed for visual inspection, as well as a suite of other sensors to detect temperature, gas/vapors, eddy-currents, proximity, and force. The CCD color cameras are aligned for human stereo-scopic viewing and the color images are displayed in stereo at the workstation. The machine vision system uses the luminance of the video signal to perform automatic flaw detection by reference image differencing. The continuous illuminators are maintained at a known illumination level by an optical transistor feedback circuit. This is Augmented by strobe illuminators that provide lighting comparable to solar illumination (when the cameras are electronically shuttered to 1/10000 sec) but only for short, energy saving, single camera frame bursts. Temperature sensing is achieved with an infrared optical pyrometer (8- 12 micron wavelength),

sensitive to temperatures from 0° to 1000°F. Gas sensing is achieved with a metal oxide semiconductor sensor, in lieu of a mass spectrometer which requires the ambient vacuum of space. Eddy-current sensing is used to detect minute cracks in the Space Station mockup structure. Proximity and force detection aid the other inspection techniques and provide collision prevention and contact force control. Parallel jaw grippers are also available to hold sensors and open compartments on the Space Station.

JSC (M. Havican, 713-483-7134)

ON-ORBIT NDE WORKING GROUP REVIVED (Charles Salkowski, 713-483-3599) - At the request of the ISSA Phase I Integrated Product Team, Marie Havican, former NN WG Chairperson, and Charles Salkowski, Deputy Branch Chief, Manufacturing and Process Development, agreed to co-chair an ISSA NDE Working Group to re-evaluate the Space Station requirements for on orbit inspection. If the ISSA NDE WG determines there is a need to address NDE for the Space Station, they will present the requirement to the VAIT. If the VAIT agrees there is a need for NDE, the WG will then evaluate the most appropriate experiment(s) and other necessary actions. The WG will call on support and information from the following persons:

S&MA	T. Lane
Risk	P. Kuo
Maintenance	K. Watson
ISSA Structures	R. Foster
Operations	M. Severance
EVA Ops & Integr.	R. Trevino
ISSA Safety Panel	Glenn Record

The ISSA NDE Working Group will provide its first status to the Phase I Board in March 1995.

LaRC (Dr. Edward R. Generazio, Head, Nondestructive Evaluation Sciences Branch, LaRC, E.R.Generazio@LaRC.NASA.GOV, 804-864-4970, FAX 804-864-4914)

THE NONDESTRUCTIVE EVALUATION SCIENCES BRANCH HAS A NEW HEAD - in January 1995, Dr. Edward R. Generazio became the Head of the Nondestructive Evaluation Sciences Branch at LaRC replacing Dr. Joseph Heyman. Dr. Edward R. Generazio received his Ph.D. in Physics from The Pennsylvania State University in 1983. Dr. Generazio was employed by NASA Lewis Research Center, Cleveland, Ohio as a senior research scientist in field of NDE for 12 years. At NASA Lewis, his activities include experimental and theoretical research in ultrasonic, eddy current, thermal and X-ray NDE for high temperature polymer, metal, and ceramic matrix composite engine materials and components. His work was focused on the manufactured quality, in-service degradation mechanisms, and life prediction of these materials. Dr. Generazio was also responsible for the development of NASA's multi-disciplinary analysis and optimization tool (T/BEST-Technology Benefit Estimator) for quantifying the benefits of introducing advanced technologies (e.g., composite materials, NDE, life prediction, etc.) into aircraft systems,

LaRC (Dr. G. Baaklini, 216-433-6016 and Dr. D.J. Roth, 216-433-6017)

REAL TIME ACOUSTO-ULTRASONIC DAMAGE CHARACTERIZATION OF SiC/CAS METAL-MATRIX COMPOSITES ESTABLISHED DURING TENSILE/FATIGUE TESTING - In real time monitoring unidirectional and cross-ply SiC/CAS composites under dynamic loading the following capabilities were demonstrated: 1) Detection of onset and saturation stress levels for matrix

cracking during quasi-static loading, 2) Registration of reduction in stiffness based on monitoring the AU parameters during the fatigue life, and 3) interference of higher ultimate strength composite corresponding to higher stress wave factor (AU parameter) determination.

UJ /TRASONIC STUDY OF THE EFFECT OF RESIDUAL STRESSES IN MECHANICAL PROPERTIES OF Ni AND Ti BASED COMPOSITES IN PROGRESS - Ultrasonic methods for measuring applied and residual stresses were successfully demonstrated on Plexiglas samples. Applicability of these methods are being investigated on Ti-24-11 and Ti-6-2-4-2. The effects of residual stresses modification on the mechanical properties of SCS-6/Ti-15-3 are also being investigated.

MSFC (R. Neuschaefer 205-544-7.382, and Dr. S. Russell, 205-544-4411)

CONTINUED STUDY OF TURBO PUMP - The Unit 11 certification lox pump for the ATD program passed the key certification test series thereby leading the way to STS-70 mission in June. The Si₃N₄ balls that had been subjected to NDE methods developed under RTOP funding passed the certification test program with no evidence of wear. Work is now underway to apply this technology to the inspection of balls and rollers for the hydrogen pump.

NN WG WORKS] 101' AT MSFC IN MAY 1995 - MSFC management and your NDE colleagues are looking forward to your participation in the NASA NDE working Group meeting to be held here May 8-10, 1995. Everything is in place for a productive meeting.

TECHNOLOGY UTILIZATION/PEGASUS LAUNCH VEHICLE - NOSE CONE AND PAYLOAD FAIRING '11 THERMAL PROTECTIVE COATING BONDLINE ASSESSMENT (Dr. S. Russell, 205-544-4411) - Orbital Sciences Corporation (OSC) requested help in determining the cause and location of bondline failure of the thermal protection coatings on the nose and payload fairings of the PEGASUS ORBCOMM mission. This mission transported into low earth orbit several OSC communication satellites and MSFC built Optical Transient Detector satellite. The ORBCOMM mission was scrubbed prior to air launch. The chase plane noticed that the nose area was almost bare of the Thermolag T230 coating and upon landing the 1,1011 carrier plane more coating peeled away and dropped onto the runway. Messieurs Floyd Roberts and Mike Prince of the Nonmetallic Division, MSFC traveled to OSC to address debond causes and process controls. Dr. Sam Russell of NDE, MSFC and Matt Lansing of UAH were included in the team to address the NDE issues and inspect the fairing with Laser Shearography (LS) for undetected unbends. MSFC's Laser Technologies Incorporated LS system was shipped by next day air freight to OSC to allow inspection of fairings. The shearography inspections confirmed the location of debonds identified with both ultrasonics (UT) and coin tapping and several previously undetected unbends were found by LS. OSC repaired the damaged areas by stripping the remaining coating on the nose cone and replacing with cork and RTV. After repairing several regions by injecting adhesive into the bondline, LS was used to check the repair for entrapped air and adhesion. A second set of fairings to be used on a later NASA Pegasus mission, SEASTAR, was inspected. An OSC technician received basic training on operating the LTHS system. OSC is using the equipment to inspect other fairings including several slated for use on NASA missions. The ORBCOMM Pegasus was launched successfully on April 3, 95.

INDUSTRY NEWS

JENTEK Sensor, Inc. (Dr. Neil Goldfine, 61 7-254-5552)

NDE CHARACTERIZATION OF THERMAL SPRAY COATING POROSITY & THICKNESS

The meandering Winding Magnetometer (MWM) is a new type of eddy current sensor designed specifically for estimating material properties. The NASA Phase 1 effort under a NASA Goddard Space Flight Center SBIR (Dr. James Chern, Contract officer's Technical Representative (COTR), phone 301-286-5836) was the demonstration of a quantitative porosity and thickness measurement suitable for real time process and quality control for thermal spray deposition processes. The demonstration of thermal spray coating characterization were done on samples fabricated at Oak Ridge National Laboratories and LeRC. One specific near-term application is characterization of oxidation protection coating for turbine blades.

NONDESTRUCTIVE TESTING INFORMATION ANALYSIS CENTER (NTIAC) (Dr. George Matzkanin, 51 2-263-2106)

The Nondestructive Testing information Analysis Center (NTIAC) is a full-service, Department of Defense information Analysis Center sponsored by the Defense Technical Information Center (DTIC) and operated under contract by Texas Research Institute Austin, inc. (TRI/Austin) in Austin, Texas. NTIAC provides a variety of information analysis products and services on nondestructive testing, evaluation, and inspection technology to the DoD; other Government agencies; Government contractors; and industry. NTIAC maintains a computerized bibliographic NDT database containing over 51,000 documents; about 200 new citations are added every month. Customized literature searches of the database can be performed providing users with references to the latest available information relating to their specific NDT problem. Other specialized databases recently compiled by NTIAC include an NDT Products and Services database, which contains information on over 8,000 companies worldwide providing NDT products, services, equipment, supplies, accessories, or training; and an NDT Standards and Specifications Database which contains information on over 1,600 NDT-related standards, specifications, recommended practices, and other requirements from more than 40 sources, both domestic and foreign. NTIAC also prepares and disseminates state-of-the-art Reports on topics of current interest (most recently, "Microwave NDE"), technical assessments, conference proceedings, and a bi-monthly current awareness publication, the "NTIAC Newsletter". Literature searches and the Newsletter are provided to Government users for no charge, while there is a modest charge for other products and services.

In addition to these basic products and services, NTIAC also provides in-depth technical assistance to Government agencies in the form of Technical Area Tasks (TATs) which are separately funded and negotiated Delivery Orders under the NTIAC contract. This technical assistance is currently being provided in a variety of areas ranging from NDE of thick composites to NDE of aging systems.

For more information, contact NTIAC at 415 Crystal Creek Drive, Austin, TX 78746; phone: (512) 263-2106; fax: (512) 263-3530; E-mail: ntiac@access.texas.gov. NTIAC information is also available through the Internet World Wide Web at address: <http://www.dtic.dla.mil/iac/ntiac/ntiachome.html>.

UNIVERSITY OF TEXAS, EL PASO (UTEP) (Roberto Osegueda, 915-747-6916)

UTEP HAS BEEN INFORMED OF AN A CONTRACT TO ESTABLISH A CENTER FOR STRUCTURAL INTEGRITY - UTEP has been awarded a 6 years contract to establish a Center for Structural Integrity of Aerospace Structures. One of the major task of this program is directed to develop NDI methods for aging aircraft structures. JPL is one of the subcontractor in this program.

COMING EVENTS (all event.f are given in EDT format)

May 8 to 10, 1995- 2nd NN WG Workshop -1 Huntsville, Al., Bob Neuschaefer, 205-544-7382

June 6-8, 1995- Nondestructive Evaluation of Aging infrastructure - Oakland, CA. SPIE, 206-676-3290

June 28-30, 1995- Joint Applied Mechanics and Materials Summer Meeting, American Society for Mechanical Engineering (ASME), Los Angeles, CA, Professor Ajit K. Maj, 310-825-5481

July 30 to August 4, 1995- 22nd Annual Review of Progress in Quantitative NDI Conference - Seattle, WA, Center for NDI, 5] 5-294-9749.

Sept. 26 to 28, 1995- Air Transport Association (ATA) 1995 NDT Forum, "NDT Technology Today: Enhancing Safety, Reliability, Savings," - Hartford, Connecticut, NAARP 609-645-2881

Dec. 4-8, 1995- JANNAP Propellant Meeting, Joint Subcommittees Meeting including NDI - Tampa, FL. CPIA 410-992-7304.

December 1996- 14th World Conference on NDT - New Delhi, India,. 1 Dr. Baldev Raj, 04117-40301

NASA NDE Working Group (NNWG) Newsletter

This NNWG Newsletter is published quarterly by the NNWG and NASA HQ, Code QW.

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